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OBLON, SPIVAK, MCCLELLAND MAIER & NEUSTADT, P.C.
1940 DUKE STREET
ALEXANDRIA, VA 22314

EXAMINER	
BARTON, JEFFREY THOMAS	

ART UNIT	PAPER NUMBER
1795	

NOTIFICATION DATE	DELIVERY MODE
01/25/2008	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patentdocket@oblon.com
oblonpat@oblon.com
jgardner@oblon.com

Office Action Summary	Application No.	Applicant(s)	
	10/799,257	NELLES ET AL.	
	Examiner	Art Unit	
	Jeffrey T. Barton	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 November 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *3,4,25-38 and 42-48* is/are pending in the application.

4a) Of the above claim(s) *42-47* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *3, 4, 25-38 and 48* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Applicant's election with traverse of phthalocyanine and derivatives thereof as the hole transport material and di- or monosubstituted perylene as the dye in the reply filed on 02 November 2007 is acknowledged. The traversal is on the ground(s) that there has been no demonstration that the species are patentably distinct, and that there would be no significant burden in searching all species together. This is not found persuasive because each species is a distinct compound requiring a separate search, using different search terms, and prior art applicable to one species would not likely be applicable to the other species. Search of all species together would thus represent a significant burden. There is no basis in the record for concluding that the species are obvious variants.

The requirement is still deemed proper and is therefore made FINAL.

2. Claims 42-47 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected species of hole transport material, there being no allowable generic or linking claim. Applicant stated that claims 46 and 47 read on the elected phthalocyanine species, but there is no disclosure in the instant specification of phthalocyanine derivatives that are polymers as claimed. Polymers are a separately listed species within claim 31 and as such, claims 46 and 47 are withdrawn as drawn to a nonelected species. Applicant timely traversed the restriction (election) requirement in the reply filed on 02 November 2007.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless.–
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 3, 29, 33, and 34 are rejected under 35 U.S.C. 102(b) as being anticipated by Goossens et al. (Chem. Vap. Deposition. 4(3)109-114.(1998))

Goossens et al disclose a method for producing a hybrid organic solar cell having the structure "Substrate+EM/SOL/dye/HTM/EM" as claimed, comprising vapor deposition of the SOL layer. (Experimental section, p. 114) CVD is used to deposit TiO_2 on fluorine-doped tin oxide disposed on a substrate (1st full sentence below Table 1), which is used to make a dye-sensitized cell with the claimed structure. (Page 114, 2nd column) The electrolyte solution is a hole transport material.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

7. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

8. Claims 4, 26, 27, and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Goossens et al in view of Yamamoto et al.

Goossens et al teach a method as described above in addressing claims 3, 29, 33, and 34.

Goossens et al do not explicitly teach vapor deposition of a second layer (Claim 4), increasing the surfaces as claimed (Claim 26), any specific substrate material (Claim 27), or using indium tin oxide as a TCO. (Claim 30)

Yamamoto et al teach that TCOs used as front electrodes in solar cells conventionally are textured, in order to increase light scattering, and thus the path length of the light, leading to increased absorption and cell efficiency. (Column 1, line 45 - Column 2, line 15) Such texture will inherently increase the interface surface area of the materials deposited on the TCO. Furthermore they teach the conventional use of indium tin oxide as a textured TCO (Column 1, lines 45-53), and the use of glass as the substrate upon which the TCO is deposited. (Column 1, lines 25-29) They also teach vapor deposition of such transparent conducting oxides. (Column 4, line 61-67)

Regarding claim 4, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Goossens et al by vapor-depositing the TCO, as taught by Yamamoto et al, because Yamamoto et al teach the suitability of vapor-deposited TCO materials for use as electrodes in solar cells. (Column 4, lines 61-67) CVD is a widely used method for TCO deposition, due to its convenience and ability to coat large surface areas at relatively low cost compared to many other deposition techniques.

Regarding claims 26, and 30, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Goossens et al by using a textured indium tin oxide TCO, as taught by Yamamoto et al, because Yamamoto et al teach that the use of a textured TCO increases cell efficiency by increasing the path length of light through the cell. A skilled artisan would have recognized that such an advantage is desirable in any class of solar cell. Furthermore, indium tin oxide is recognized in the art as essentially equivalent to fluorine-doped tin

oxide in its function as a transparent conductor. The choice of either would have been obvious to one having ordinary skill in the art.

Regarding claims 27, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Goossens et al by specifically using a glass substrate, as taught by Yamamoto et al, because the glass is a rugged, inexpensive, light-transmissive substrate, as is well recognized in the art. Its use as a substrate for solar cells is conventional due to these advantages.

9. Claims 27, 28, 30, 31, 37, and 38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Goossens et al in view of Nakamura.

Goossens et al teach a method as described above in addressing claims 3, 29, 33, and 34.

Goossens et al do not explicitly teach any specific substrate material (Claim 27), a flexible substrate (Claim 28), using indium tin oxide as a TCO (Claim 30), any of the claimed HTMs (Claim 31), using plural dyes in a cell (Claim 37), or using a doped HTM. (Claim 38)

Regarding claims 27 and 28, Nakamura discloses disposing dye-sensitized cells on numerous types of substrates, including flexible polymers. (Column 5, line 52 - Column 6, line 21; particularly Column 6, lines 8-11)

Regarding claim 30, Nakamura discloses a variety of TCO materials, including ITO. (Column 5, lines 52-65)

Regarding claim 31, Nakamura discloses numerous hole transport materials, including triphenylamine derivatives and polythiophenes. (Column 27, line 37 - Column 28, line 30; particularly column 27, line 60 and Column 28, lines 19-20)

Regarding claim 37, Nakamura discloses using more than one dye in a cell. (Column 8, lines 10-13)

Regarding claim 38, Nakamura discloses a doped HTM. (Column 28, lines 23-30)

Regarding claims 27, and 28, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Goossens et al by specifically using a flexible polymeric substrate, as taught by Nakamura, because Nakamura suggests that these are "competitive" (Column 6, lines 9-11), and a skilled artisan would have recognized the desirability, convenience, and marketability of flexible solar cells as being highly desirable.

Regarding claim 30, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Goossens et al by using indium tin oxide as the transparent conductor, as taught by Nakamura, because indium tin oxide is recognized in the art as essentially equivalent to fluorine-doped tin oxide in its function as a transparent conductor, as evidenced by Nakamura listing them together, describing both as being suitable. (Column 5, lines 59-63) The choice of either would have been obvious to one having ordinary skill in the art.

Regarding claims 31 and 38, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Goossens et al by replacing the redox-couple electrolyte with a solid doped hole-transporting material, as taught by Nakamura, because it would reduce concerns with leaks and solvent evaporation in self-contained cells. All of the materials listed by Nakamura are known to be suitable for hole transport in this class of cells, and the selection of any would have been obvious to a skilled artisan.

Regarding claim 37, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Goossens et al by using more than one dye in a cell, as taught by Nakamura, because Nakamura teaches that this broadens the region of wavelength conversion, which increases cell efficiency. (Column 8, lines 10-13)

10. Claims 30-32, 36, and 38 rejected under 35 U.S.C. 103(a) as being unpatentable over Goossens et al in view of Saurer et al.

Goossens et al teach a method as described above in addressing claims 3, 29, 33, and 34.

Goossens et al do not explicitly teach using indium tin oxide as a TCO (Claims 11, 30), any of the claimed HTMs (Claims 12, 13, 31, and 32) or using a doped HTM. (Claims 19, 38)

Saurer et al teach a method of making a hybrid solar cell including using an indium tin oxide electrode material (Column 3, lines 30-35; Column 4, lines 42-48;

Figure 5), and using doped phthalocyanines, such as copper phthalocyanine as a hole transport material. (Column 6, lines 36-57; with an n-type titanium dioxide electrode, such material lying between the electrodes is inherently a hole-transporting material in a functional cell, and should obviously be p-type) The titanium dioxide electrode of Saurer et al is disclosed as being as thin as 100 nm. (Column 4, lines 54-56)

Regarding claim 30, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Goossens et al by using indium tin oxide as the transparent conductor, as taught by Saurer et al, because indium tin oxide is recognized in the art as essentially equivalent to fluorine-doped tin oxide in its function as a transparent conductor, as evidenced by Saurer et al listing them together, describing both as being suitable. (Column 3, lines 30-35; Column 4, lines 42-48) The choice of either would have been obvious to one having ordinary skill in the art.

Regarding claims 31, 32, and 38, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Goossens et al by replacing the redox-couple electrolyte with a solid hole transport material, such as doped CuPc, as taught by Saurer et al, because it would reduce concerns with leaks and solvent evaporation in self-contained cells and because Saurer et al teach these materials' suitability in carrying out this function in hybrid cells.

Regarding claim 36, the Examiner's position is that the thickness of the semiconducting oxide layer is a parameter variable by a skilled artisan, depending on the desired degree of transparency, for instance, where two TCO materials are used as

electrodes. The principle by which the cells function is not altered by this thickness, and the Federal Circuit has held that, where the only difference between the prior art and the claims was a recitation of relative dimensions of the claimed device and a device having the claimed relative dimensions would not perform differently than the prior art device, the claimed device was not patentably distinct from the prior art device. *Gardner v. TEC Systems, Inc.*, 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), *cert. denied*, 469 U.S. 830, 225 USPQ 232 (1984). Since the dye penetrates through much of the depth of the semiconducting oxide in cells of this type, a dye layer with the claimed thickness would obviously be present in a cell with the claimed oxide layer thickness.

11. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Goossens et al in view of Yu et al and either Saurer et al or Nakamura.

Goossens et al teach a method as described above in addressing claims 3, 29, 33, and 34.

Goossens et al do not explicitly teach providing a layer of lithium fluoride near an electrode material, or such a layer having a thickness of 0.1 to 50 Å.

Saurer et al and Nakamura teach solid organic hole transfer materials, with both teaching use of polyphenylenevinylenes for this purpose. (Saurer et al - Column 6, lines 36-48; Nakamura et al - Column 28, lines 17-18) The obviousness of using these materials as hole transport materials as replacements for the electrolyte of Goossens et al was argued in the preceding paragraphs.

Yu et al teach that a 1-30 nm film of LiF between a polyphenylenevinylene semiconductor layer and an aluminum counter electrode improves the short circuit current and off-state voltage of a photovoltaic device. (Column 19, lines 55-58)

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Goossens et al by using a solid HTM, such as PPV, as taught by either Nakamura or Saurer et al, for the reasons given in the preceding paragraphs. It would further have been obvious to use a 1-30 nm film of LiF between the HTM and Al counter electrode, as taught by Yu et al, because Yu et al teach that this improves the short circuit current and off-state voltage of a photovoltaic device. (Column 19, lines 55-58)

12. Claims 35 and 48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Goossens et al in view of Sakurai et al. (US 6,310,282)

Goossens et al teach a method as described above in addressing claims 3, 29, 33, and 34.

Goossens et al do not explicitly teach a dye that is a di- or monosubstituted perylene as claimed.

Sakurai et al teach dye sensitized photovoltaic cells in which a perylene diimide is used as the sensitizing dye. (Column 14, line 66 - Column 15, line 6; Column 31, line 56-62; Column 33, lines 31-38)

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Goossens et al by replacing the ruthenium

dye with a perylene diimide dye, as taught by Sakurai et al, because Sakurai et al teaches the suitability of perylene diimide dyes as dyes for use in dye sensitized photovoltaic cells. The selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945).

Response to Arguments

13. Applicant's arguments filed 29 May 2007 have been fully considered but they are not persuasive.

Applicant points out purported differences between the vapor deposited SOL of the instant disclosure and that taught by Goossens et al, contrasting the fractal-type morphology and film thicknesses of Goossens et al with the morphology and thicknesses of the SOL layer taught by Applicants. This is not persuasive because instant claim 3 includes no limitations corresponding to such arguments. Regarding the SOL layer, claim 3 only limits the SOL layer position relative to other layers, and requires that it be vapor-deposited. Goossens et al clearly anticipates these limitations, as well as all others of the claim. Insofar as these arguments pertain to claim 36, Applicant has provided no evidence of criticality of the claimed SOL layer thickness, or demonstrated a difference in essential function of the cell dependent on such thickness. Accordingly, claim 36 is considered obvious over the prior art as applied above, since SOL layers as thin as 100 nm are known in the prior art, and the cells would apparently function in the same manner. Note the citation to *Gardner v. TEC Systems, Inc.* above.

Conclusion

14. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dr. Jeffrey T. Barton whose telephone number is (571) 272-1307. The examiner can normally be reached on M-F 9:00AM - 5:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

JTB
17 January 2007

NAM NGUYEN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700